DOCUMENT RESUME

ED 042 601 SE 008 059

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TITLE The Construction (Using Multi-Media Techniques) of Certain Modules of a Programmed Course in Astronomy-Space Sciences for NASA Personnel of The Goddard Space Flight Center, Greenbelt, Maryland.
INSTITUTION Morgan State Coll., Baltimore, Md.
PUB DATE Feb 70
NOTE 8p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (43rd, Minneapolis, Minn., March 5-8, 1970)

EDRS PRICE EDRS Price MF-$0.25 HC-$0.50
DESCRIPTORS Adult Education, *Aerospace Technology, Astronomy, *Autoinstructional Aids, *Curriculum, Instructional Materials, *Multimedia Instruction, Program Descriptions, *Programed Units

ABSTRACT

This paper describes the development of a self-instructional multi-media course in astronomy-space sciences for non-technical NASA personnel. The course consists of a variety of programed materials including slides, films, film-loops, filmstrips video-tapes and audio-tapes, on concepts of time, space, and matter in our solar system and galaxy. General objectives of the program, and the evaluation of the achievement of these objectives are discussed. Proposals for the development of three additional autoinstructional modules are presented. In addition, the author states his intention of using control and experimental groups to evaluate the success or failure of the program. (LC)

FEB 27 1970

ED042601

# The Construction (using Multi-Media Techniques) of Certain Modules of a Programmed Course in Astronomy-Space Sciences for NASA Personnel of The Goddard Space Flight Center Greenbelt, Maryland

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by

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February, 1970

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## INTRODUCTION

One of the important areas of activity of the National Aeronautics and Space Administration is keeping their professional, engineering, and non-technical "in house" personnel abreast of recent developments in space science research. Due to the astronomy research capability at Goddard Space Flight Center, it was decided, in 1967, to proceed with the development of an auto-instructional course in astronomy and space sciences for Goddard personnel. A plan was drawn up which devised a three-track approach to the program: one track each for professional, engineering, and non-technical groups. Behavioral objectives were established for each group, and modular course development (using multi-media techniques) began with the non-technical population in 1968.

Morgan College learned of this on-going research early in 1969, and submitted an unsolicited research proposal for $16,164, during the summer of 1969. This proposal was designed specifically to assist NASA in the development of "hardware" and "software" for the University Division of the National Aeronautics and Space Administration in August, 1969, and the research was begun in September of that year.

## STATEMENT OF THE PROBLEM AND OBJECTIVES

The specific object of this research is to develop, through educational technology modes, and to evaluate, using freshmen non-science majors at the college, a self-instructional course in astronomy-space sciences. The research this first year has been confined to the major area of the program entitled,

"The Vastness of the Universe". By means of programmed materials (tapes, slides, films, film-loops, film strips, video tapes, and audio tapes) specific topics dealing with time, space, and matter in our solar system and galaxy have been constructed for the non-technical student. It is self-evident that the auto-instructional modules developed for those individuals with little or no college training would not be used with either engineers or those holding professional degrees at the Goddard Space Flight Center. This means that two additional auto-instructional, programmed courses using multi-media techniques will have to be developed, each with varying degrees of quantitative rigor, some time in the future.

## OBJECTIVES AND DESCRIPTION OF THE PROGRAM CONTENT

The following concepts for the non-technical track of the programmed astronomy-space sciences course have been developed as of this writing:

MAJOR AREA: THE VASTNESS OF THE UNIVERSE

TOPIC 1. A MODEL OF THE SOLAR SYSTEM

I. The Nature of Scale Models
   A. Making the real object comprehensible
   B. Developing the Scale: Sizes, Nature, Time

II. A Scale for the Solar System: Size, Distance, and Organization
   A. Sizes of bodies in the solar system
   B. The Astronomical Unit as a yardstick
   C. Organization of bodies in the solar system
   D. Distance between objects in the solar system

Three original four-minute films have been made by the researchers to illustrate these concepts. In addition, commentaries for nine commercially available loops illustrating these concepts have been taped. Four hundred 35 mm slides have been sequen-

tially programmed (with dialogue) for use in Burgess Audio-Tutorial booths. Two hundred pages of programmed instruction in mathematics for astronomy have been written and the culminating activity of the module is the Modern Learning Aids Film entitled, "Measuring Large Distances", narrated by Fletcher Watson.

The following modules will be prepared during the remainder of this academic year:

TOPIC 2. A MODEL OF GALAXIES

I. Review of Solar Scale and Attempt to Use for Milky Way
   A. Inadequacy of Solar System Scale
   B. The Light Year as a Measuring Device

II. The Milky Way Galaxy
   A. The Distribution of Stars
   B. The Organization of Stars

III. Beyond the Milky Way
   A. The Organization of Galaxy Types
   B. The Distribution of Galaxies
   C. Galaxy Types and Theories

Two of the general objectives of the non-technical track program are (1) to stimulate a continuing interest in Astronomy and Space Sciences, and (2) to provide the students with some basic tools of information and techniques with which they may continue a study of astronomy in formal courses or as a hobby.

The success of the general objectives will be measured by observing the student's involvement by three or more of the following behaviors:

1. He will request astronomy-space science programs which will meet his own interests.

2. He will pursue a formal (i.e., credit) course in Astro-

nomy or space science.

3. He will involve his family and/or friends in hobby-like astronomy activities.

4. He will utilize the astronomy materials in the Goddard Space Flight Center library.

5. He will occasionally participate in the astronomy club activities of the Goddard Space Flight Center.

6. He will become an active member of the Goddard Space Flight Center Astronomy Club.

If the grant is continued during the 1970-1971 academic year, these following modules should be completed:

MAJOR AREA: ENERGY-FORCE CONTENTS OF THE UNIVERSE

TOPIC 3. THE ORGANIZATIONAL RESULTS OF GRAVITATION AND MOTION

I. Inertial Mass and Universe Content Motion

II. Mass and Gravitation
- A. Sun and Solar System
- B. Earth-Moon System
- C. Galactic System

III. Cosmological Theories
- A. Origin
- B. Destiny

TOPIC 4. ELECTROMAGNETIC ENERGY AND TECHNIQUES FOR STUDYING

I. Observing in the Visible Spectrum Range
- A. The Unaided Eye
- B. Binoculars
- C. Cameras
- D. Telescopes
- E. Spectroscopy

II. Observing in the Higher Frequency Range
- A. Ultra Violet
- B. X-Rays
- C. Gamma Rays

III. Observing in the Lower Frequency Range
    A. Infra-Red
    B. Radio

Additional time will be needed to develop the following auto-instructional modules:

TOPIC 5. THE SATELLITE AS A TOOL FOR STUDYING ASTRONOMY

I. Restrictions of Land-Based Observations
    A. The Atmosphere As a Filter
    B. Sizes of Instruments

II. Restrictions of Satellite Astronomy
    A. Instrument Size (Radio & Optical)
    B. Motions
    C. Information Coding
    D. Aiming

III. Probes
    A. Mars
    B. Venus

This research is necessarily bifurcated. Initially, the auto-instructional material, both "hardware" and "software" must be developed, and secondarily, control and experimental groups shall be match-paired to establish the success or failure of the program through the measurement of level difference between groups by a Z-ratio technique. "Impedence matching" of the students will be based on the following criteria:

1. Identical composite test scores on ACT examination
2. Similar scores on the mathematical and natural science segment of the ACT exam
3. Similar high school averages
4. Similar standings in high school graduating classes.

The ultimate success or failure of the program will be determined by validated pre- and post- test techniques as well as

correlated unit examinations during the term.

Students at the college have assisted in the research by constructing several of the models, making some films, and taping a few dialogues. The research has depended much on trial and error, and serependipity has been the rule rather than the exception. For example, in order to obtain two hundred feet of "canned" super 8mm sound film, we shot well over one thousand feet!

## SUMMARY

The benefit to both NASA and Morgan State College, as a result of this research, is obviated by the fact that NASA will have a portion of its proposed course in Astronomy-Space Sciences prepared, evaluated, and packaged with per student cost comparisons between an auto-instructional multi-media program and a "conventionally presented program"; while Morgan College will (a) receive materials essential to progressive instruction in Astronomy and Space Sciences, (b) enjoy a student-instructor joint participation relationship in research, and (c) establish considerable expertise in the development of educational technology "hardware" and "software" thereby affording the principal investigators an opportunity to compete favorably for additional grants with agencies and foundations other than NASA.